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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : B23Q 16/00	A1	(11) International Publication Number: WO 96/29176
		(43) International Publication Date: 26 September 1996 (26.09.96)

(21) International Application Number: PCT/US95/10543

(22) International Filing Date: 17 August 1995 (17.08.95)

(30) Priority Data:
08/405,679 17 March 1995 (17.03.95) US

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(81) Designated States: AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TT, UA, UG, UZ, VN, ARIPO patent (KE, MW, SD, SZ, UG), European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

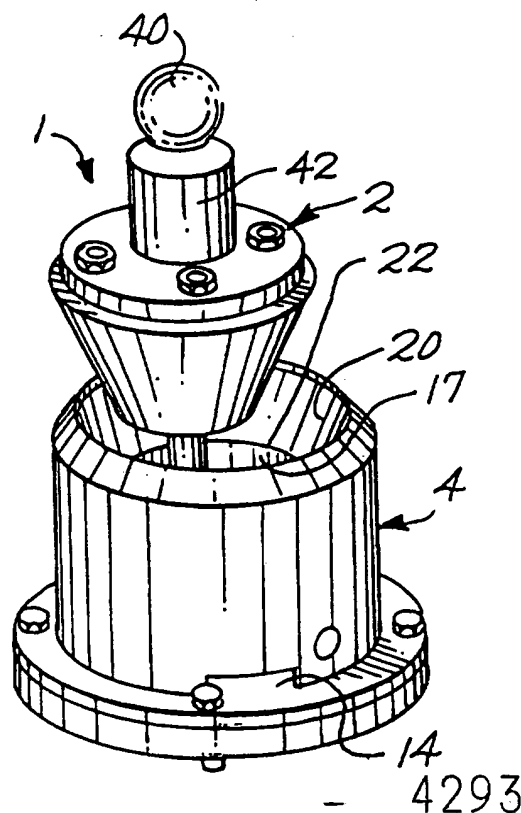
Published*With international search report.*

Vorlage	Ablage	5/1899
Haupttermin		
Eing.: 02. MRZ 2005		
PA. Dr. Peter Riebling		
Bearb.:	Vorgelegt.	

(54) Title: SELF LOCATING DEVICE FOR FIXTURING VERY LARGE OBJECTS

(57) Abstract

Large objects can be easily fixtured in self locating devices (1) comprising nests (4) with frustoconical bores (18) attached to the support structure and cooperating frustoconical shaped locating units (2) attached to the object. The locating units (2) are roughly lined up with the nests (4) and the object is then lowered onto them.



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SELF LOCATING DEVICE FOR FIXTURING VERY LARGE OBJECTS

5 This invention relates to a self locating device suitable for fixturing very large objects such as fuselage sections of commercial aircraft. More particularly the invention relates to a self locating device having cooperative nesting and locating units which keep the object secure during manufacture but facilitate rapid and rigid placement in the fixture.

10 BACKGROUND

Many work pieces, small and large, must be secured in fixtures for further manufacturing operations. Fixturing large objects at multiple location points, particularly in a manner to provide easy access to the greatest possible area of a work piece, has been difficult.

15 For example, large commercial aircraft are manufactured in sections weighing several tons each which are later joined together for final assembly. Traditionally, fuselage sections have been suspended on heavy duty cranes and lowered onto multiple location points. The points comprise pins on the fixture which fit into slots in plates attached to the exterior of the fuselage along the water line. Dislocation
20 during or after fixturing can result in damage to the work piece or stress on it during manufacture. The parts are also vulnerable to displacement during earthquakes.

In the past, one method of rigidly supporting work pieces, particularly very large ones, involves creation of a so called bed of nails. In such an arrangement, the work piece is supported from beneath at several locations on pegs having
25 heights which match the work pieces contour. For example, U.S. Patent No. 4,121,817 to Provosky shows pins having conical contact points for supporting a work piece which is clamped into position. U.S. Patent No. 5,026,033 to Roxey

shows a bed of nails having stanchions which are threaded into holes. The tips of the stanchions have means to tighten down the work piece. U.S. Patent No. 5, 163,793 to Martinez shows a bed of nails for resting large parts where the top portion of each vertical support member is gimbaled to provide for full contact with
5 contoured work pieces.

U.S. Patent No. 4,834,358 to Okolishin, et al shows a fixturing system featuring two or more locating pins which fit into parallel bores in the work piece. The patent shows moving the locating pins by allowing them to travel in holes drilled in a fixturing plate at required spacings.

10 None of the patents cited above satisfactorily meets the needs for accurately fixturing large work pieces at multiple location points.

BRIEF SUMMARY

A self locating device is provided at each fixturing point for rapidly securing
15 objects or work pieces in fixtures for further manufacturing. This invention relates particularly to self locating devices suitable for holding very large, heavy objects in fixtures at multiple location points.

The device comprises a lower nesting unit which is a solid cylinder with a frustoconically shaped bore in it. The bore tapers inwardly from the top surface of
20 the nest. The nest is mounted on a locating base unit and has a horizontal pivot linkage beneath the taper of the bore comprising a horizontal shaft that extends from a pivot point on one side of the nest to a slot on the other side of the nest. A horizontal locator pin is attached to this shaft and extends upward through the bore. A spring is located between the top of the shaft and the base which supports the
25 weight of the locating unit and prevents premature seating of the work piece before it is finally positioned.

The locating upper unit comprises a frustoconical shaped lower section which is sized to seat in the tapered bore in the nesting unit. The upper part of the locating unit is adapted to fit into a receptacle on the work piece. For example, a locating ball which is sized to fit within a receptacle for it on the objects to be
5 fixtured, much like a ball and hitch for a trailer, would be suitable.

To lower a work piece on one or more such locating devices, the upper locating unit is attached to the workpiece and the lower unit to the supporting structure. The work piece is brought to within a few inches of its final resting place and the horizontal locator pin is inserted a short distance into a bore in the
10 frustoconical lower section of the upper locating unit for a rough location. The entire work piece is then gently lowered onto the one or more locating devices where it is perfectly and permanently located by the nesting of the frustoconical lower section of the upper unit into the complimentary bore in the nest unit. A lock pin is inserted
15 between the locating ball and the lower section of the locating unit to prevent any vertical motion. The nesting of the frustoconical cross section element prevents any lateral movement of the work piece and the mass of the workpiece resting on the nested elements prevent lateral motion.

Our invention will be better understood in terms of the several figures and detailed description which follow.

FIGURES

FIGURE 1 is the view of a self locating device in accordance with the invention suitable for fixturing an airplane section at one location point including a lower nesting unit and an upper locating unit before the units are in the nested
25 position.

FIGURE 2 is similar to FIGURE 1 after the upper locating unit has settled in the nesting unit.

FIGURE 3 the self locating device of FIGURE 1 with the upper locating unit shown at several possible locations in hashed lines.

5 FIGURE 4 is a side sectional view of a self locating device shown in FIGURE 3.

FIGURE 5 shows a perspective view of the upper locating unit and selected features of the lower nesting unit and base including the rider plate and the horizontal linkage for the horizontal link pin.

10 FIGURE 6 is a perspective view of the locating unit with the locating ball locked into position on the locating unit with a lock pin prior to seating the locating unit.

FIGURE 7 is a top sectional view of the horizontal linkage mechanism in the base unit showing alternate positions of the mechanism in hashed lines.

15 FIGURE 8 is a perspective view of the self locating device after the work piece has been secured.

FIGURE 9 is a side view of the locating device after the work piece has been secured on a scaffold.

DETAILED DESCRIPTION

20 Referring to FIGURES 1 to 4, a self locating device 1 suitable for fixturing objects on a supporting framework is shown. Device 1 comprises upper locating unit 2 and lower nesting unit (nest) 4. Base plate 6 of nesting unit 4 is secured to attach plate 8 by bolts 10. Additionally, lateral movement of plate 8 can be allowed by loosening bolts 10 until locating unit 2 is seated in nesting unit 4 and then
25 tightening bolts 10.

As best seen at FIGURE 4, nest 4 has a right circular cylindrical channel 16 therethrough. A frustoconical shaped bore 18 extends from tapered nest rim 20 part way down channel 16 to point 22.

Rider plate 12 on attach plate 8 extends through notches 14 in the nest 4.

5 Horizontal locating pin assembly 24 is mounted in nest 4. Assembly 24 comprises horizontal linkage shaft 26 biased on rider plate 12 in notch 14. Shaft 26 rotates on pivot pin 28 through linkage 30. Linkage pin 32 is carried on slider 34 which travels on shaft 26. Pin 36 supports pin cover 38. The freedom of movement of linkage pin 32 is best seen in FIGURE 7 which shows how assembly 24 moves when
10 manipulated in upper locating unit 2 as shown at FIGURE 3.

Upper locating unit 2 comprises locating ball 40 on shank 42. Circumferential notch 44 is indented between ball 40 and shank 42. In the preferred embodiment shown, shank plate 46 and shank 42 are integral to one another. Referring particularly to FIGURE 4, frustoconical lower section 48 is secured to shank plate 46
15 by bolts 50. A cylindrical bore 52 extends upwardly from bottom 54 of section 48 into shank 56. Bevel 58 from bottom 54 to bore 52 facilitates location of pin cover 38 in bore 52 before a workpiece is settled onto a nest 4.

Referring to FIGURE 6, upper locator unit is secured in a receptacle 60 in a locating block 62 on or attached to a workpiece. Pin 64 has threads 66 for screwing
20 it into block 62. Locating ball 40 is held in place by inserting pin 64 into circular notch 44. Movement of pin 64 is prevented by tie 68 which is threaded through hole 70 and eyelet 72 on shank plate 46.

To use the self locating devices described above, and with particular reference to FIGURES 8 and 9, body fitting jig 76 is attached to side 74 of a section
25 of airplane fuselage. Locating block 78 of jig 76 has receptacle 80 for a locating ball 40 and threaded hole 82 for receiving a pin 64 to lock ball 40 in place.

Upper locating unit 2 is attached to fitting jig 76 by pushing ball 40 into receptacle 80 and inserting pin 64 into bevel 58. Unit 2 is somewhat free to swing on ball 40 which facilitates its alignment with nesting unit 4. Nesting unit 4 is fastened to platform 84 which is secured by crosspiece 86 to supporting scaffold 88.

5

Once upper unit 2 and lower unit 4 of each fixturing location point are secured, a fuselage section 75 is gently lowered from above the devices 1 such that top 90 of horizontal locator pin 32 is located very slightly above bottom 92 of lower frustoconical section 48. Units 2 and 4 are then manipulated by hand at each
10 fixturing location so that pin 32 is located within bore 52 in bottom cone 54. This can be accomplished by swinging upper unit 2 on ball 40 and/or compressing spring 37 and moving locator pin 32 around as illustrated in FIGURES 1, 3 and 7. Once each pin 32 is secured in a bore 52, section 75 is lowered slowly until each section 48 rests squarely in cooperating nest 5. The shape of section 48 and cooperating
15 shape of nest 5 provide the "self locating" feature of the invention. Pin 32 prevents any vertical movement of the object with respect to the support, while the weight of the workpiece bearing down on nest 5 prevents lateral motion. Further motion of pin 32 can be prevented by stringing a wire 94 with security tag 96 through hole 98 in pin 32 and eyelet 100 on shank plate 46.

20

The invention has been disclosed in terms of the preferred embodiment, but other arrangements of the key elements also fall within its scope. For example, the relative positions of female nest section 5 and cooperative cone 48 could be reversed, i.e., the nest be located on the upper locating unit and the cone on the lower locating unit. In another alternative method, the scaffolding could be raised to
25 meet a stationary workpiece rather the workpiece being lowered on a stationary scaffold.

While our invention has been described in terms of specific embodiments thereof, other forms may be readily adapted by one skilled in the art. Accordingly, the scope of the invention is to be limited only by the following claims.

CLAIMS

1. A self locating device for fixturing an object comprising a nesting unit and a cooperating locating unit wherein said device

said nesting unit comprises a stationary nest having a frustoconical bore therein, said bore tapering inwardly from the rim of the nest; a horizontal locating pin assembly beneath the taper of said bore, said assembly comprising a horizontal linkage shaft extending from a pivot point on one side of the nest to a slot on the other side of the nest; a horizontal locator pin attached to said shaft and extending upward through said bore, said pin serving to align the locating unit with the nesting unit before the workpiece is finally positioned; and

said locating unit comprising a frustoconical lower section sized to seat in said tapered bore in said nest; an upper section having means to movably secure said locating unit to a said object; and a bore into the bottom of the frustoconical lower section sized to receive the horizontal locator pin.

2. A self locating device, wherein several said devices used together are suitable for fixturing very large objects, said device comprising a nesting unit and a cooperating locating unit wherein said device

said nesting unit comprises a nest having a frustoconical bore therein, said bore tapering inwardly from the rim of the nest; a horizontal locating pin assembly beneath the taper of said bore, said assembly comprising a horizontal linkage shaft extending from a pivot point on one side of the nest to a slot on the other side of the nest; a horizontal locator pin attached to said shaft and extending upward through said bore, said pin being spring loaded such that it can be depressed and moved within the bore to assist in aligning said locating unit with said nesting unit before the workpiece is finally positioned; and wherein

said locating unit comprises a frustoconical lower section sized to seat in said tapered bore in said nest; an upper section having a locating ball sized to fit within a

receptacle on a said large object; and a bore into the bottom of the frustoconical lower section sized to receive the horizontal locator pin.

3. A method of fixturing an object using one or more self locating devices, wherein a said device comprises a nesting unit and a cooperating locating unit

5 wherein said device

said nesting unit comprising a nest having a frustoconical bore therein, said bore tapering inwardly from the rim of the nest; a horizontal locating pin assembly beneath the taper of said bore, said assembly comprising a horizontal linkage shaft extending from a pivot point on one side of the nest to a slot on the other side of the
10 nest; a horizontal locator pin attached to said shaft and extending upward through said bore, said pin being spring loaded such that it can be depressed and moved within the bore to assist in aligning said locating unit with said nesting unit before the workpiece is finally positioned; and wherein

said locating unit comprises a frustoconical lower section sized to seat in said
15 tapered bore in said nest; an upper section having a locating ball sized to fit within a receptacle on a said large object; and a bore into the bottom of the frustoconical lower section sized to receive the horizontal locator pin

wherein a said object is fixtured by bringing said lower section and said upper section into proximity to one another such that said locator pin protrudes slightly into
20 the bore in the frustoconical section and thereafter allowing said locating unit to settle completely into said nest.

4. The method of claim 3 wherein the object is an aircraft section and wherein a plurality of said devices are used.

5. The device of claim 1 where the means to movably secure the locating
25 unit to the object is a ball on the locating unit and a receptacle in or attached to the

object with means to secure the ball while allowing freedom of movement of the locating unit before it is secured in the nest.

6. A self locating device for fixturing an object comprising a nesting unit and a cooperating locating unit wherein said nesting unit comprises a stationary nest
5 having a frustoconical bore therein, said bore tapering inwardly from the rim of the nest; and wherein said locating unit comprises a frustoconical lower section sized to seat and self center in said tapered bore in said nest.

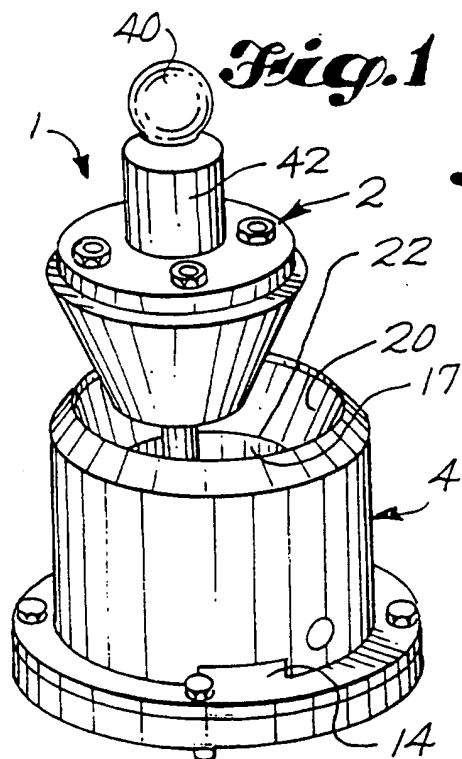


Fig. 3

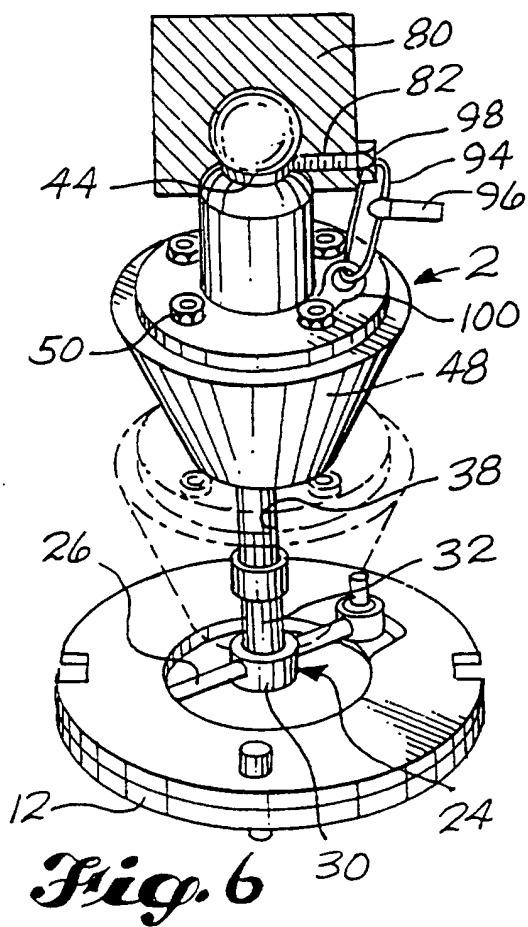
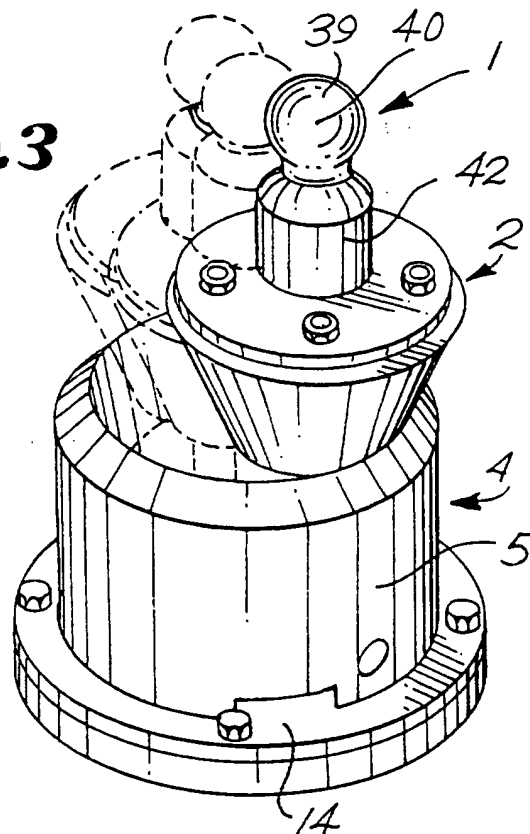
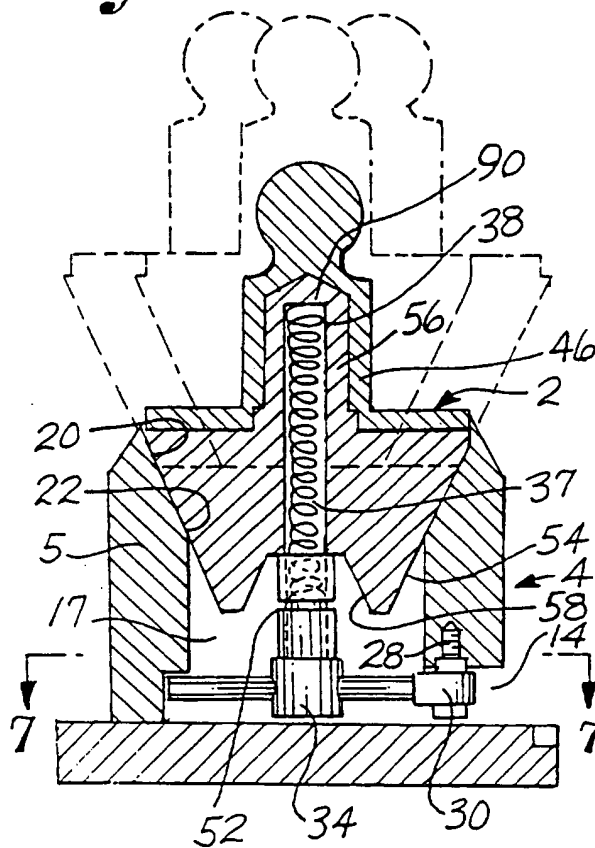
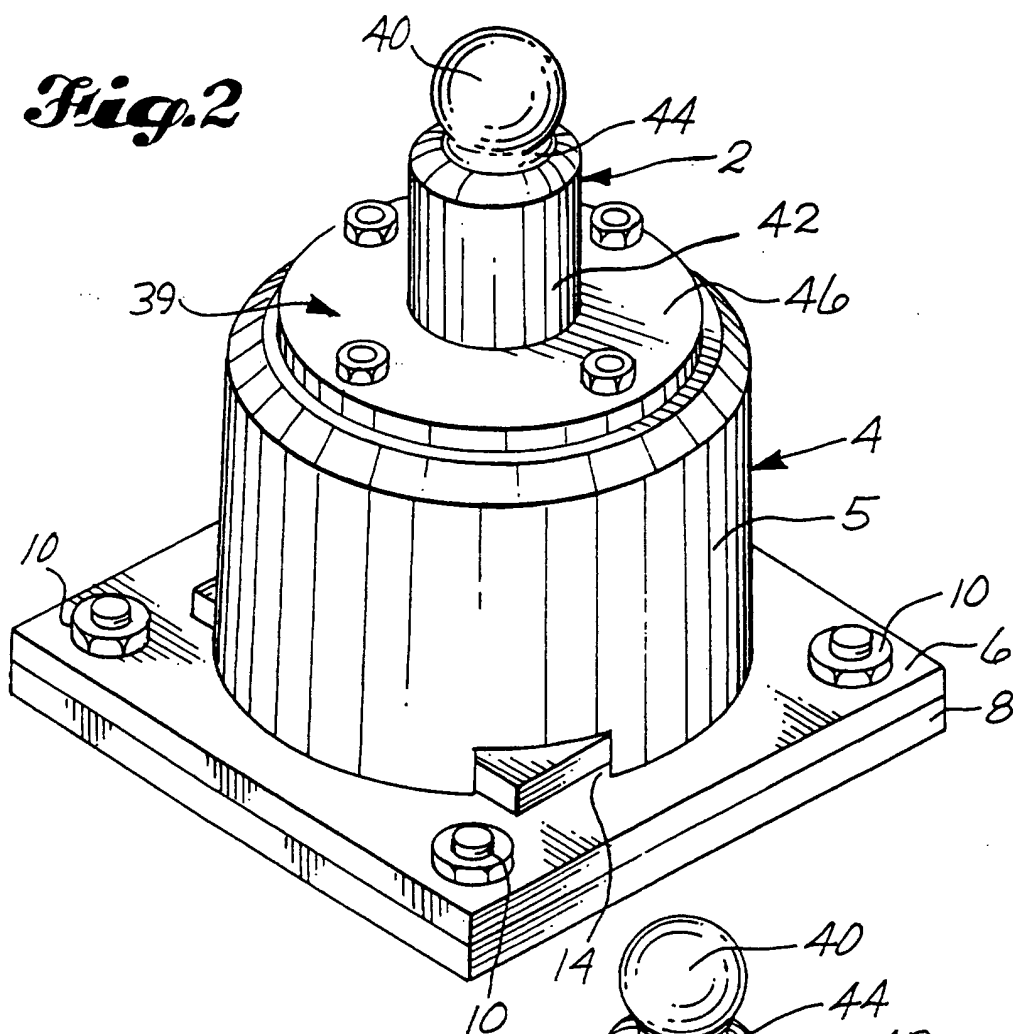
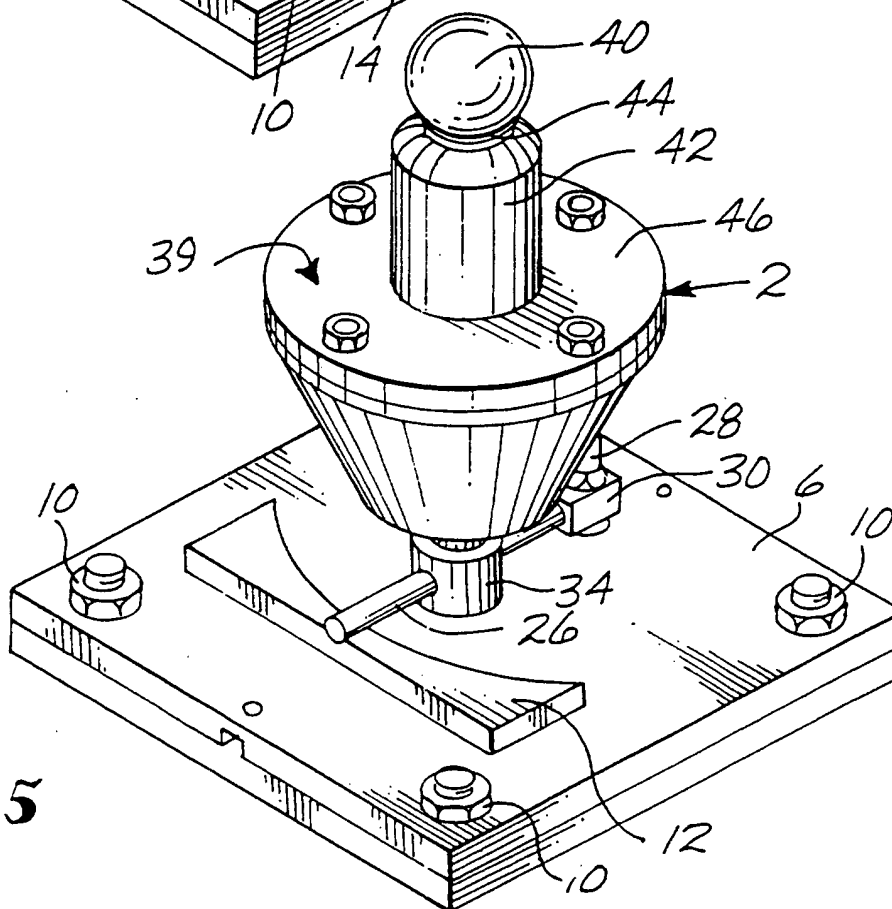


Fig. 4



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Fig. 2**Fig. 5**

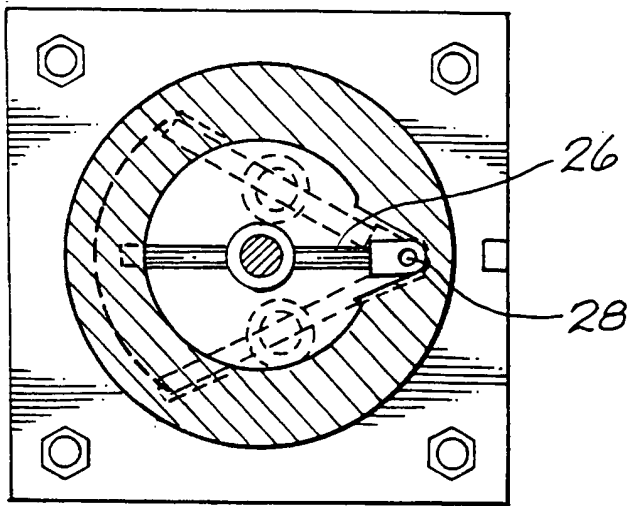


Fig. 7

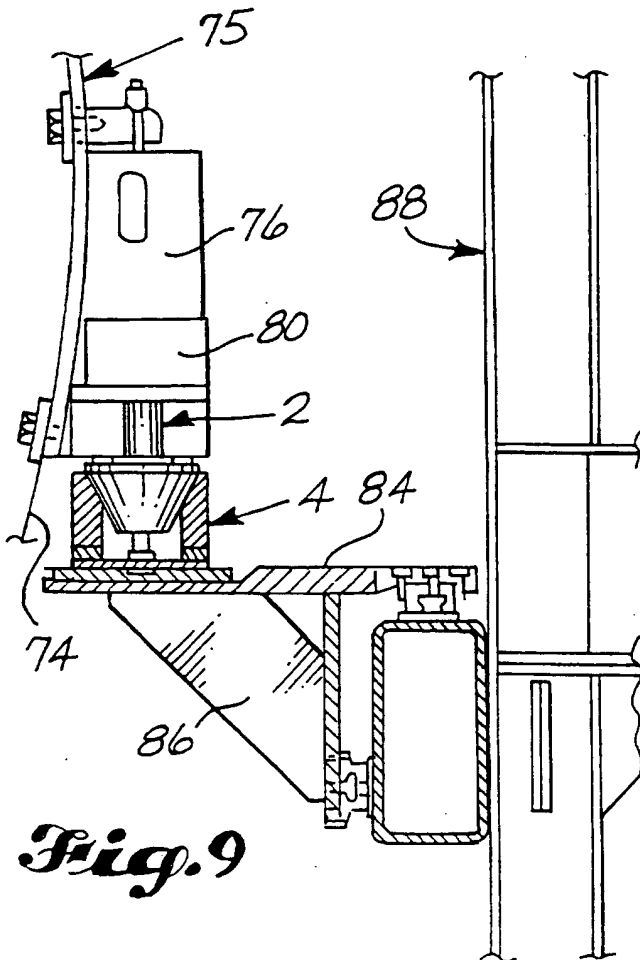


Fig. 9

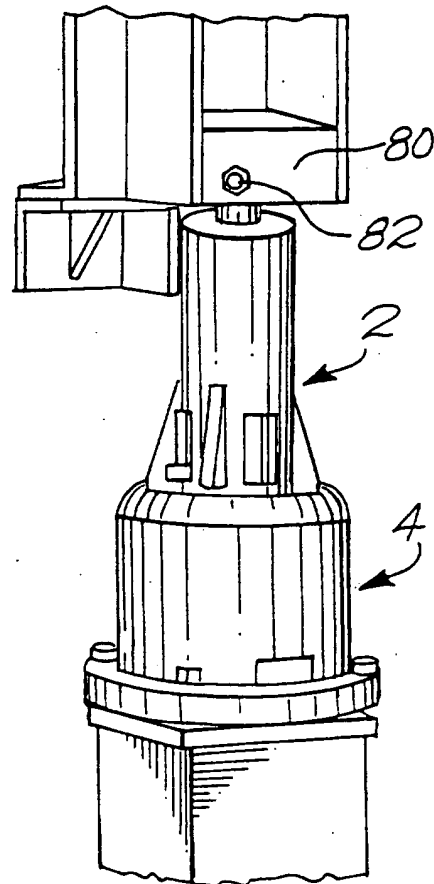


Fig. 8

INTERNATIONAL SEARCH REPORT

Int: **nal Application No**

PCT/US 95/10543

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 B23Q16/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 B23Q F16M

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Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP,A,0 459 544 (PHILIPS GLOEILAMPENFABRIEKEN) 4 December 1991	6
A	see the whole document ---	1-4
A	EP,A,0 374 091 (MATHYS AG) 20 June 1990 see column 3, line 4 - line 23; figure 1 ---	1-3,6
A	EP,A,0 330 905 (HAUSER) 6 September 1989 see column 4, line 49 - line 55 see column 7, line 14 - line 17; figure 1 ---	1-3,6
A	US,A,5 305 992 (KISH) 26 April 1994 see abstract; figures 1-6 -----	1-5

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☒ Patent family members are listed in annex.

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